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FLOWER-BREEDING *DROSOPHILA* OF BOGOTA, COLOMBIA: NEW SPECIES (DIPTERA: DROSOPHILIDAE)

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Abstract.—There are two taxonomic groups of flower-breeding *Drosophila* in Bogota, Colombia and its environs, at altitudes of 2500 m and higher. The *onychophora* species group of the subgenus *Drosophila* is characterized by wide ovipositor plates studded with many stubby teeth. Thirteen species in this group are in the Bogota region: *D. bifurcada* NEW SPECIES, *D. choachi* NEW SPECIES, and *D. arane* NEW SPECIES are described here. A key for the 13 species is given. The *onychophora* group of flies breed in several genera of composites and other families, and some species are monophagous. Four species of the *flavopilosa* species group in the Bogota region breed in flowers of *Cestrum* (Solanaceae). This group in the subgenus *Drosophila* is characterized by a strongly spined ovipositor.

Key Words.—Insecta, Diptera, *Drosophila, onychophora, flavopilosa,* flower-breeding, Bogota

Over several years of collecting in the region around Bogota, Colombia, I found at least 50 different species of *Drosophila.* This is a considerable diversity for an altitude of 2500 m and higher and an average temperature of 15° C. For a majority of these, the breeding sites were not found. However, 17 were found breeding in live flowers. These *Drosophila* are largely in two main groups: the *flavopilosa* group (Wheeler et al. 1962) which breeds only in flowers of *Cestrum,* and the *onychophora* group (Vilela & Bachli 1990), with a characteristic toothed ovipositor, which breeds in flowers of several genera (Hunter 1979, 1988). In the Bogota region, there are at least 13 species in the *onychophora* group, 10 previously described (Hunter 1979, 1988) and three described in this paper. There are three other species in the *onychophora* group that are found in Bolivia and Peru and are described by Duda (1927). The Colombian species have eggs without filaments that are laid in the buds of their host flowers.

METHODS

Specimens have been deposited in the California Academy of Sciences. The hosts were identified by Enrique Forero of the Universidad Nacional de Bogota. The characters of the imagines given here are based largely on the holotype male; however, the body and wing lengths are average values for five live males and five live females. The wing indices are measured on slide preparations of five female and five male wings. The diagrams of genitalia are based on slide preparations of terminalia from several specimens.

TAXONOMY

Drosophila bifurcada Hunter, NEW SPECIES
(Fig. 1)

Types.—Holotype #15854: male; data: COLOMBIA, BOGOTA: aqueduct watershed of mountain Monserrate, 2600 m, 20 Aug 1980, A. S. Hunter; deposited:

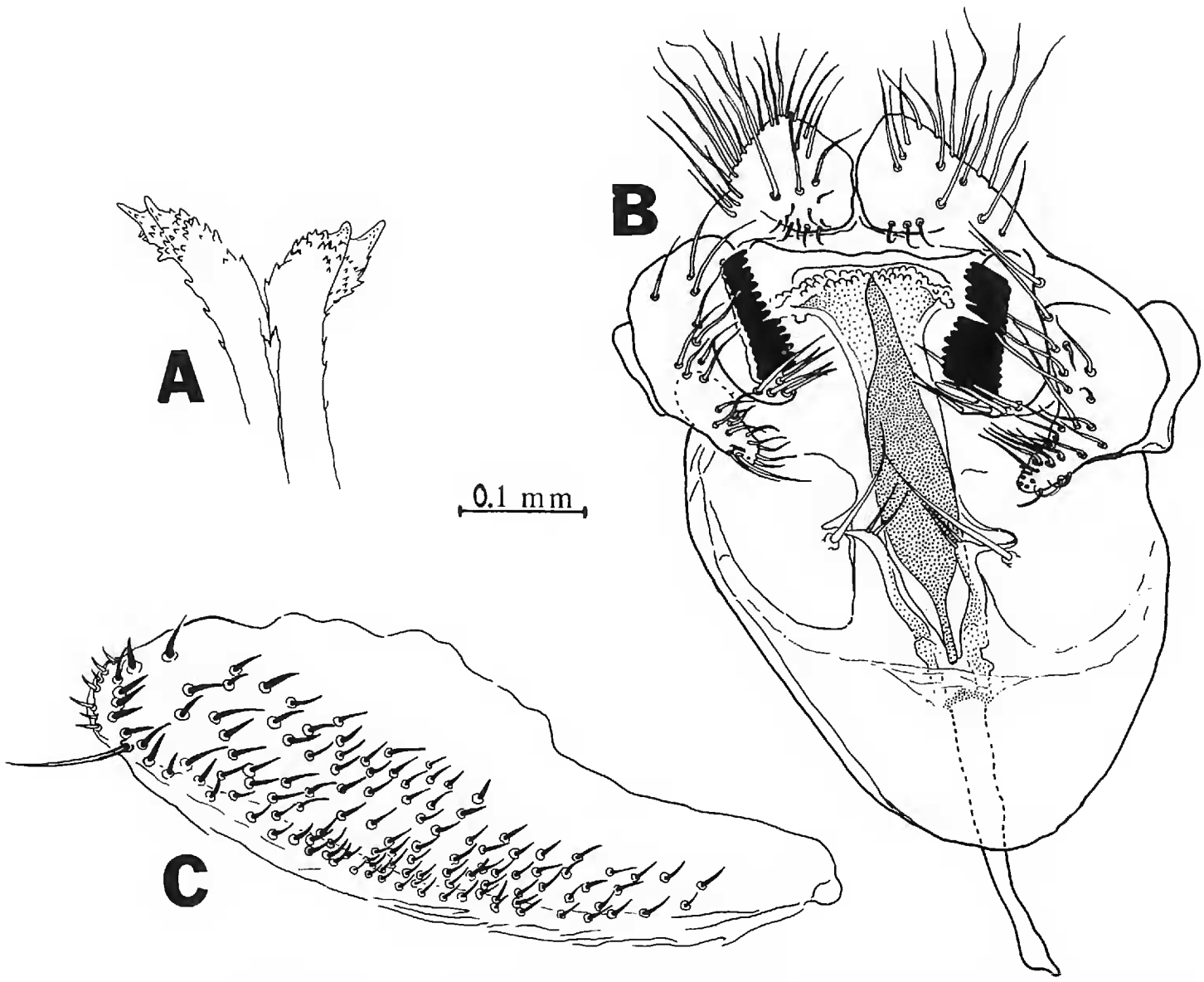

Figure 1. Genitalia of *Drosophila bifurcada,* A. tip of aedeagus, B. male terminalia, C. right ovipositor plate.

California Academy of Sciences, San Francisco. Paratypes: 3 females, 3 males; same data as holotype; deposited: California Academy of Sciences.

Description.—Male.—Arista with three dorsal, two ventral branches plus a terminal fork. Basal antennal segments tan; third segment brown; one medium and one short bristle on second segment. Frontal and ocellar triangles dark brown. Proclinate orbital bristle 0.75 × length of posterior reclinate; anterior reclinate one-third of posterior. Face brown; carina moderately high, narrow, slightly sulcate. Cheek tan; one long oral bristle. Distance from border of eye to base of first oral 0.2 × greatest diameter of eye. Eyes dark red; eye index 1.1. Palpus pale tan with one long, several medium length hairs. Acrostichal hairs in six rows between dorsocentrals; no prescutellars; anterior scutellars divergent. Thorax shiny brown with a pair of light stripes through dorsocentral bristles; scutellum and pleura shiny brown; halter pale tan. Anterior sternopleural bristle 0.66 × length of posterior; middle sternopleural 0.5 × length of anterior. Legs pale tan with darker terminal tarsal segment. Small apical and pre-apical bristles on first tibia; apical and pre-apical bristles on middle tibia; pre-apicals on third tibia; several thin bristles on front femur. Wing pale tan with slightly darker veins. Costal index 4.3, fourth vein index 1.5, 4c index 0.5, 5× index 1.2. Thicker hairs on anterior border to basal two-fifths of third section of costa. Abdomen brown, each tergite with narrow black band. Body length 2.9 mm; wing length 4.1 mm. Genitalia (Fig. 1): aedeagus pale tan, very slight dorsoventral curve; apex bifurcate, each tip secondarily bifurcate; tips serrate. Aedeagal apodeme thick, straight. Epandrium articulated with anal plate dorsoposteriorly; row of six bristles on medial surface projecting over surstyli; laterally, eight bristles; thick tuft of ten bristles on ventral lobe. Surstyli with 14 black primary teeth; fine, short black hairs all over surface; six short, tan bristles at anterior end. Surstyli united by wide, dorsal bridge (decasternum). Hypandrium with long, medioventral bristle on each side; finger-like gonapophyses with three yellow hairs.

Female.—Thorax slightly darker than that of male. Body length, 3.1 mm. Wing length, 4.1 mm. Spermatheca dark brown, spherical. Ovipositor plate brown, curved, many fine teeth (about 120) all over lateral surface; row of seven small teeth at rounded, dorsoposterior apex; one long bristle at ventroposterior apex.

Egg.—Pointed anteriorly; no filaments.

Larva.—First instar present in genital chamber of female has mandibular hook with bifurcate tip.

Diagnosis.—The many teeth on the ovipositor plates and the lack of egg filaments are characteristics of the *onychophora* group of *Drosophila* from Bogota. The bifurcate apex of the aedeagus distinguishes this species from others of the group.

Distribution.—*D. bifurcada* has been found along the river on mountain Monserrate, which is the watershed for the Bogota aqueduct.

Hosts.—Adult *D. bifurcada* emerge from pupae in the flowers of both *Liabum megacephalum* Schultze and *Bidens rubifolia* Humboldt (Asteraceae).

Material Examined.—See types.

Drosophila choachi Hunter, NEW SPECIES
(Fig. 2)

Types.—Holotype #15856: male; data: COLOMBIA, BOGOTA: road to Choachi on mountain Guadelupe, 2700 m, 13 Aug 1980, A. S. Hunter; deposited: California Academy of Sciences, San Francisco. Paratypes: 1 female, 2 males; same data as holotype; deposited: California Academy of Sciences.

Description.—*Male.*—Arista with two dorsal, one ventral branches plus a terminal fork. Basal antennal segments gray-brown; two bristles on second segment. Proclinate orbital bristle two-thirds length of posterior reclinate; anterior reclinate one-half length of posterior reclinate. Face gray-black; carina moderately high, not sulcate. Cheek black; one long oral bristle; palpus and proboscis tan-gray. Distance from border of eye to base of first oral bristle one-fifth of greatest diameter of eye. Eye bright red; eye index 1.1. Acrostichal hairs in 6 rows between dorsocentrals; no prescutellar bristles; anterior scutellars divergent. Thorax semi-shining black. Anterior sternopleural bristle 0.66 × length of posterior; middle sternopleural 0.5 × first, very thin. Legs yellow-tan, except coxa, proximal two-thirds of femur and last tarsal segment which are brown. Apical bristles on middle tibia and pre-apical bristles on all tibiae; five medium to long bristles on first femur. Wings pale gray with slightly darker veins. Costal index 4.8, fourth vein index 1.7, 4c index 0.5, 5× index 1.3. Thicker hairs along wing border to basal half of third section of costa. Abdomen yellow-tan, first two tergites with posterior black band wider in midline, fading out laterally. Body length, 2.6 mm. Wing length 2.7 mm. Genitalia (Fig. 2): aedeagus tan with brown tip; C-shaped curvature toward left; apex in shallow S-shaped curve; apodeme broadens at base. Epandrium articulated with posterior, lateral corners of hypandrium; row of seven long, tan hairs on medial border; group of four medium length hairs on anterior, medial apex. Surstyli with eight black, primary teeth; six small teeth on inner surface. Surstyli united by wide, dorsal bridge (decasternum). Hypandrium with long, medioventral bristle on each side; broad gonapophyses each with three medium length yellow bristles.

Female.—Abdomen brown-gray with black bands on posterior half of each tergite. Body length, 2.9 mm. Wing length, 3.0 mm. Spermatheca dark brown, ovoid. Curved ovipositor plate studded with about 140 short, stubby, black teeth; three long, one medium hairs on dorsal apex; four medium length hairs on ventral apex.

Egg.—Apex tapers to fine point; no filaments.

Diagnosis.—The many teeth on the ovipositor plate and lack of egg filaments are characteristic of the *onychophora* group of *Drosophila* from Bogota. The shape of the aedeagus (Fig. 2) and teeth of surstyli distinguish *D. choachi* from other species in this group.

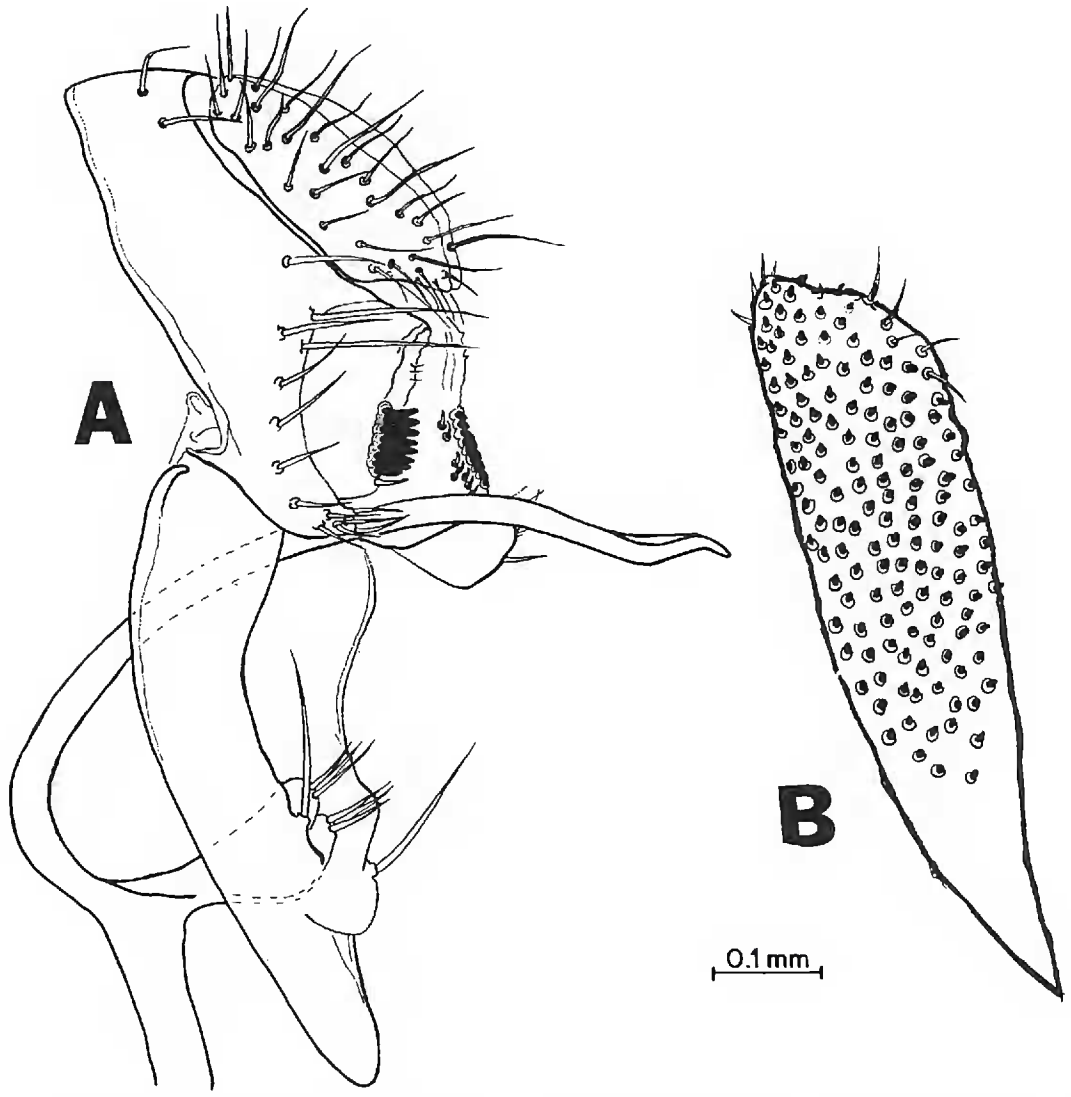

Figure 2. Genitalia of *Drosophila choachi,* A. male terminalia, B. right ovipositor plate.

Distribution.—*Drosophila choachi* has only been found in the paramo of Choachi on mountain Guadelupe.

Host.—Adults emerged from flowers of *Eupatorium vaccinaefolium* Benth (Asteraceae).

Material Examined.—See types.

Drosophila arane Hunter, NEW SPECIES
(Fig. 3)

Types.—Holotype #15853: male; data: COLOMBIA, BOGOTA: aqueduct watershed of mountain Monserrate, 2600 m, 12 Aug 1980, A. S. Hunter; deposited: California Academy of Sciences, San Francisco. Paratypes: 3 females, 3 males; same data as holotype; deposited: California Academy of Sciences.

Description.—*Male.*—Arista with three dorsal and one ventral branches plus terminal fork. Basal antennal segments dark brown; two medium hairs on second segment. Frontal and ocellar triangles light brown, bordered by dark brown. Proclinate orbital bristle two-thirds length of posterior reclinate; anterior reclinate one-half of posterior. Face brown; carina high, narrow, not sulcate. Cheek brown; one long oral bristle. Distance from border of eye to base of oral bristle one-fifth of greatest diameter of eye. Eye sepia; eye index 1.1. Palpus brown with many fine, medium length hairs. Acrostichal hairs pale yellow, in six rows between dorsocentrals; no prescutellars; anterior scutellars divergent; posterior dorsocentrals same length as scutellar bristles. Thorax brown-black. Halter pale tan. Anterior sternopleural bristle one-half length of posterior; middle sternopleural one-half length of anterior. Legs shaded from black femur to brown tibia to tan tarsus, excepting last tarsal segment which is brown.

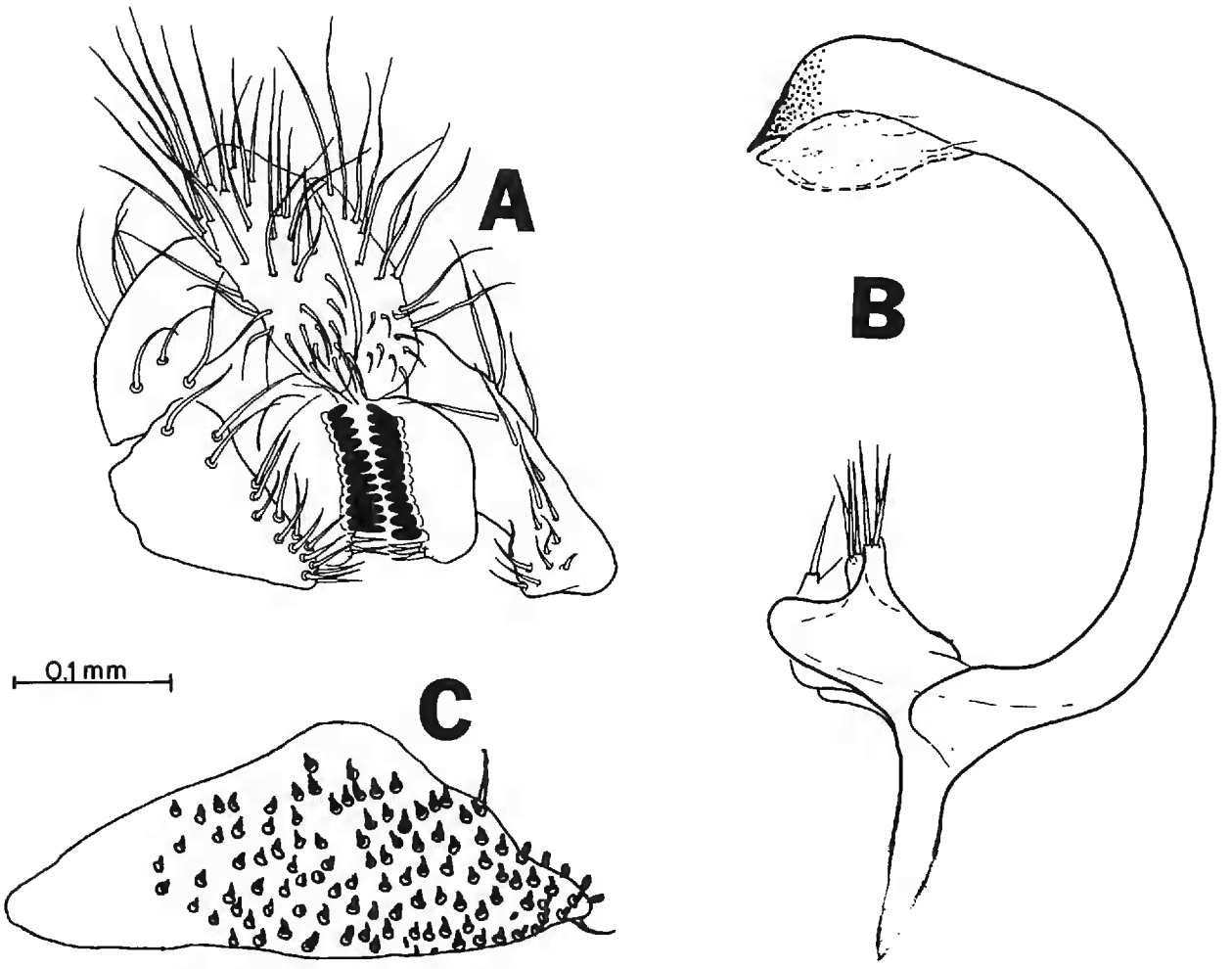

Figure 3. Genitalia of *Drosophila arane,* A. male terminalia, B. aedeagus, C. left ovipositor plate.

Apical and preapical bristles on middle legs, apical on first and pre-apical on third. Wings pale tan with slightly darker veins. Costal index 3.8, fourth vein index 1.6, 4c index 0.7, 5× index 1.1. Abdomen brown with darker band bordering posterior margin of each tergite. Body length 2.7 mm. Wing length, 3.6 mm. Genitalia (Fig. 3): aedeagus tan with sharply pointed black tip on scoop-shaped apex, apodeme thin, slightly curved. Epandrium articulates with anal plate dorsoposteriorly; row of five bristles extends from medial surface to overlap surstyli; tuft of six bristles on toe. Surstyli with 13 primary teeth; four stubby teeth on internal surface. Hypandrium with long, medioventral bristle on each side; finger-like gonapophyses, each with three to four long, yellow bristles.

Female.—Body length, 2.9 mm. Wing length, 3.7 mm. Spermatheca brown, spherical. Ovipositor with pointed apex; wide plates studded with about 100 short, stubby, black teeth; one long bristle dorsally; one yellow hair on ventral apex.

Egg.—Pointed anteriorly, no filaments.

Pupa.—Anterior spiracles have three long and five very short branches.

Diagnosis.—The many teeth on the ovipositor plate and lack of egg filaments are characteristic of the *onychophora* group of *Drosophila* from Bogota. The pointed tip of the ovipositor plates and the straight row of 13–14 primary teeth on the surstyli distinguish *D. arane* from other flies of this group.

Distribution.—*Drosophila arane* has been found along the river that is the aqueduct watershed from the mountain Monserrate in Bogota. The host flowers border the river just above the guard house.

Hosts.—Eggs, larvae and pupae of *D. arane* were found in flowers of *Siegesbeckia jorullensis* H.B.K. and *Liabum megacephalum* Schultze (Asteraceae).

Remarks.—Arane is the latin word for spider and refers to the appearance of this fly, which is that of a small spider with long, dark legs and compact body.

Material examined.—See types.

Key to *Drosophila* species of the *onychophora* group in Bogota and environs.

1a. Wings long (at least 4.4 mm); costal index (length of second costal section/third costal section) at least 5.0; arista with four upper and two lower branches + terminal fork: associated with flowers of *Bomarea* 2
1b. Wing length less than 4.4 mm; costal index <5.0; arista with only two to three upper branches; associated with flowers of genera other than *Bomarea* 3
2a. (1a). Cheeks white ..... *D. carablanca* Hunter
2b. Cheeks tan ..... *D. bomarea* Hunter
3a. (1a). Body narrow (like *Scaptomyza*), steel gray on live flies; associated with *Espeletia* flowers of paramo of Chisaca .....*D. chisaca* Hunter
3b. Body form and color variable (distributed in Bogota and environs) ... 4
4a. (3b). Costal index from 4.2 to 4.9 5
4b. Costal index less than 4.2 8
5a. (4a). Eight rows acrostichal hairs, thorax brown, abdomen dark grey to black, wings smoky, associated with *Cleome* flowers .... *D. desbaratabaile* Hunter
5b. Six to eight rows acrostichal hairs, other traits variable, not associated with *Cleome* flowers 6
6a. (5b). Arista with two upper, one lower branches plus terminal fork; thorax semi-shining black; eyes bright red; associated with *Eupatorium* .....*D. choachi* NEW SPECIES
6b. Arista with three upper, one to two lower branches + terminal fork; thorax brown; eyes dull red to burgundy color; associated with various different flowers 7
7a. (6b). Arista with three upper, two lower branches + terminal fork; thorax brown with lighter stripes through dorsocentrals; eyes burgundy; associated with *Liabum* and *Bidens* ..... *D. bifurcada* NEW SPECIES
7b. Arista with three upper, one lower branches + terminal fork; thorax unicolorous grey-brown; eyes dull red; associated with *Espeletia* ... . *D. freilejoni* Hunter
8a. (4b). Thorax tan to light brown 9
8b. Thorax dark brown to black 11
9a. (8a). Arista with two upper, three to two lower branches + terminal fork; six rows of acrostichals; abdomen tan with dark brown bands, wider on anterior segments and in midline; associated with *Liabum* and *Bidens* ..... *D. colmenares* Hunter
9b. Arista with three upper, one lower branches + terminal fork; seven to eight rows acrostichals; other traits variable 10
10a. (9b). Light brown thorax with central darker stripe; abdomen yellow-orange with tan bands more marked anteriorly and fading posteriorly and laterally; associated with *Liabum* and *Bidens* .... *D. franii* Hunter
10b. Thorax unicolorous light brown with green hue; abdomen tan with dark bands interrupted medially, thinning laterally; associated with *Montanoa* (crazy tree) ..... *D. arboloco* Hunter
11a. (8b). Small body, 2.0–2.3 mm long, wings less than 3 mm long; eight

rows of acrostichals; associated with *Chrysanthemum, Liabum* and *Bidens* ..... *D. margarita* Hunter

11b. Body length greater than 2.5 mm; wings 3 mm or longer; six to seven rows of acrostichals 12

12a. (11b). Arista with two upper, one lower branches + terminal fork; short, plump body shape; associated with *Liabum* ... *D. acuminanus* Hunter

12b. Arista with three upper, one lower branches + terminal fork; "spidery" body shape; associated with *Siegesbeckia* .... *D. arane* NEW SPECIES

Discussion

The best way to identify these species is by their genitalia (Figs. 1–3) (Hunter 1979: figs. 1–6; Hunter 1988: figs. 1–9). Drawings of the ovipositor plates show the differences in overall shape and distribution of teeth and hairs. Surstyli and aedeagi are distinctive for each species.

Drosophila of the *onychophora* group are not attracted to yeasted fruit or vegetable baits as most other drosophilids are. The flies rest on the host plant(s) and frequently occur inside the flower. A convenient way to obtain adults is to collect old flowers that are drying out, and allow the adults to emerge from the pupae within the flowers. In places where the host plants are abundant, adults may be swept with a net over the flowers. There is an area on the south bank of the river of the watershed on Monserrate mountain in Bogota (about 100 m above the guarded entrance) where five of the species occur. *Drosophila franii, D. arane, D. acuminanus, D. colmenares* and *D. bifurcada* occur on *Bidens, Liabum* and *Siegesbeckia* along this bank.

Both *D. bomarea* and *D. carablanca* were found only in the trumpet-shaped red blossoms of the *Bomarea* vine that occurs along the road to Choachi paramo in the region which overlooks the savanna of Bogota. On this same part of the road there are trees of *Montanoa ovalifolia* DC (Asteraceae) in which *D. arboloco* is found. Closer to the paramo, purple-flowered bushes of *Eupatorium* grow, and a few specimens of *D. choachi* emerged from these flowers. On the paramo of Choachi there are several different species of *Espeletia* in which *D. freilejoni* breeds. *Drosophila chisaca* is only collected in the paramo of Chisaca, about 50 km south of Bogota. Of the 13 species of the *onychophora* group found in Colombia, 11 breed in composite flowers and five appear to be monophagous.

These drosophilids were referred to as the "anthophilic group" in previous descriptions (Hunter 1979, 1988) because of their close association with flowers. Vilela & Bachli (1990) renamed the group based on the first species that had been described by Duda (1927), and also placed the group in the subgenus *Drosophila.* All of the 16 species of this group described to date were collected at 2500 m and higher in the Andes. Another undescribed species with genitalia typical of the group was collected at 3000 m in Ecuador (specimens in California Academy of Sciences). The wide ovipositor with many teeth on the lateral surface may be an adaptation for inserting eggs into the buds of flowers. The lack of egg filaments may be related to the type of substrate in which the eggs are laid. This characteristic is found in other flower-breeding *Drosophila* such as the *flavopilosa* group. Ovoviviparity was observed in *D. bifurcada, D. arane* and seven other species of this group (Hunter 1988). This has also been noted in other flower-breeding *Drosophila* and is perhaps of adaptive value in the flower niche. Although some of the

characteristics of these flies are suggestive of a relationship to the subgenus *Phloridosa,* Vilela & Bachli (1990) believe that they evolved independently.

The other major group of *Drosophila* of the Bogota environs that breeds in live flowers includes at least four species of the *flavopilosa* group (Wheeler et al. 1962). It is characterized by the distinctive ovipositor that has heavy black spines on the posterior edge. The eggs lack filaments or have very short ones. These flies breed in flowers of *Cestrum* species. They occur in the same locality where several species of the *onychopora* group are breeding in *Bidens, Liabum,* and *Siegesbeckia,* along the watershed between the mountains, Monserrate and Guadelupe. Several species of *Cestrum* grow there and are hosts to at least four species of the *flavopilosa* group. Although the two groups of plants are only a few meters apart, the flies of the *onychophora* and *flavopilosa* group occur on separate plants. The *Drosophila* of the *flavopilosa* group do not fly around much, but rest on the plants where they have to be aspirated or shaken off.

Drosophila acroria (Wheeler et al. 1962) is the most abundant of the *flavopilosa* species in the Bogota region. It occurs in several different sites, associated with *Cestrum parvifolium* Wild (Solanaceae). Two other species found in the watershed of Monserrate appear to have identical ovipositors with those described by Wheeler et al. (1962) as "unnamed species 3" and "unnamed species 6." The latter is distinctive, because it is tan and black, while other *flavopilosa* species are yellow. A fourth species that does not fit any published descriptions is found associated with *C. petiolare* and *C. tomentosum.*

Several species of unidentified *Drosophila* were found in the white flowers of *Datura* along with many *Zapriothrica.* Possibly these *Drosophila* feed on yeasts growing on decaying flowers, since no larvae occur in the intact live flowers on the bushes.

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